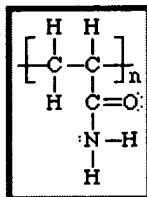


# EXHIBIT A

# poly(acrylamide)



Polyacrylamide is used for water treatment and paper manufacturing, and in applications requiring water soluble polymers.

## Properties of Acrylamide Monomer

sight	white, solid crystals
molecular weight	71.08
melting point	84 deg C
density	1.122 g/ml at 30 deg C
solubility in acetonitrile	40 g/ 100 ml at 30 deg C
solubility in acetone	63 g/ 100 ml at 30 deg C
solubility in benzene	0.346 g/ 100 ml at 30 deg C
solubility in ethanol	86 g/ 100 ml at 30 deg C
solubility in water	215 g/ 100 ml at 30 deg C

## Synthesis of acrylamide monomer:

1. react acrylonitrile sulfuric acid in an aqueous solution, and then separate acrylamide out using a base.
2. hydrate acrylonitrile using a fixed-bed copper catalyst.

In one example of this, a reduced CuO-Cr<sub>2</sub>O<sub>3</sub> catalyst was used at 85 deg C in a continuous fixed-bed reactor using a 7% solution of acrylonitrile in water as the feed, with near quantitative conversion.

U.S. patent 3,631,104 (1971) C. E. Habermann, B. A. Terfertiller (Dow Chemical)

## Polymerization of polyacrylamide

- o If heated above the melting point, acrylamide may polymerize. Caution, the reaction is exothermic.
- o Acrylamide may be polymerized in water at concentrations from 8- 20%, using AIBN, peroxide, or redox catalysts. Reaction times may range from 4- 8 hrs. Temperatures from 20 to 50 deg C are common. CAUTION: This reaction may **exotherm**. It is recommended that you follow a specific procedure (DON'T MAKE ONE UP using the information you see here.) Even if you are following a procedure, use caution--assume the reaction may run away from you.

### Water solubility of polyacrylamide

Poly(acrylamide) is infinitely soluble in water. In a way this is counterintuitive because we are accustomed to thinking of a polymer solution as consisting of a polymer dissolved in some small molecule substance.

If you keep adding polyacrylamide to water, eventually you pass a point where there is more polymer than water, and then you have a solution of water dissolved in polymer. I believe in this scenario, the term "infinitely soluble" means there will be no phase separation.

On the other hand, if you have a polymer and solvent where the polymer is not infinitely soluble, there is a point where if you pass that point, and then let time pass, the polymer and the solvent media will phase separate.



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*Last Update- July 9, 1995- wld*

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